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Quasi-Experimental Evaluation Of Text-Based Crisis Patterns In Youth Following Hurricane Florence In The Carolinas, 2018

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Abstract

Importance: Crisis text lines have proven to be an effective and low-cost means for delivering texting-based mental health support to youth. Yet there has been limited research examining the use of these services in capturing the psychological impact of youth affected by a weather-related disaster. *Objective:* This ecologic study examined changes in help-seeking behavior for youth in North and South Carolina, USA, before and after Hurricane Florence (2018). *Design and Main Outcomes:* A retrospective, interrupted time-series design was used to examine pre- and post-hurricane changes in crisis text volume among youth help seekers in the Carolinas for the following outcomes: (1) text for any reason; (2) stress & anxiety; (3) depression; and (4) suicidal thoughts. *Results:* Results showed an immediate and sustained increase in crisis texts for stress/anxiety and suicidal thoughts in the six weeks following Florence. Overall, an immediate 15% increase in crisis texts for anxiety/stress (SE=.05, p=0.005) and a 17% increase in suicidal thoughts (SE=.07, p=0.02) occurred during the week of the storm. Text volume for anxiety/stress increased 17% (SE=.08, p=0.005) and 23% for suicidal ideation (SE=.08, p=0.01) in the 6-week post-intervention period. Finally, forecast models revealed observed text volume for all mental health outcomes was higher than expected in the 6 weeks post-Florence. *Conclusions and Relevance:* A low-cost, crisis texting intervention platform provided 24/7 mental health support available to young people in the Carolinas impacted by Hurricane Florence. These findings highlight a new application for text-based crisis support services to address the mental health consequences among individuals following a weather-related disaster.

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Highlights

- Limited research on mobile crisis counseling services following weather-related disasters.
- Low-cost, crisis texting platform provided 24/7 mental health support available to youth
- Notable increase in crisis help-seeking behaviors for youth in Carolinas post-Hurricane Florence, 2018
- Parallel increase in emergency department volume for mental conditions among youth in impacted communities

ABSTRACT

IMPORTANCE Crisis text lines have proven to be an effective and low-cost means for delivering texting-based mental health support to youth. Yet there has been limited research examining the use of these services in capturing the psychological impact of youth affected by a weather-related disaster.

OBJECTIVE This ecologic study examined changes in help-seeking behavior for youth in North and South Carolina, USA, before and after Hurricane Florence (2018).

DESIGN AND MAIN OUTCOMES A retrospective, interrupted time-series design was used to examine pre- and post-hurricane changes in crisis text volume among youth help seekers in the Carolinas for the following outcomes: (1) text for any reason; (2) stress & anxiety; (3) depression; and (4) suicidal thoughts.

RESULTS Results showed an immediate and sustained increase in crisis texts for stress/anxiety and suicidal thoughts in the six weeks following Florence. Overall, an immediate 15% increase in crisis texts for anxiety/stress (SE=.05, p=0.005) and a 17% increase in suicidal thoughts (SE=.07, p=0.02) occurred during the week of the storm. Text volume for anxiety/stress increased 17% (SE=.08, p=0.005) and 23% for suicidal ideation (SE=.08, p=0.01) in the 6-week post-intervention period. Finally, forecast models revealed observed text volume for all mental health outcomes was higher than expected in the 6 weeks post-Florence.

CONCLUSIONS AND RELEVANCE A low-cost, crisis texting intervention platform provided 24/7 mental health support available to young people in the Carolinas impacted by Hurricane Florence. These findings highlight a new application for text-based crisis support services to address the mental health consequences in youth following a weather-related disaster,

as well as the potential for these types of interventions to measure situational awareness in impacted communities.

INTRODUCTION

Climatic variability and associated changes in weather patterns are creating new mental health risks and exacerbating existing healthcare disparities.[1,2] Since the early 1980s, significant changes in the intensity, frequency, and duration of North Atlantic hurricanes have been observed.[3] In the Southeastern US, climate change is projected to increase sea-level rise and heavy precipitation events, as well as the frequency and intensity of weather-related disasters, such as tropical cyclones.[3,4] The coast of the Southeastern region of the United States is particularly vulnerable to sea-level rise, storm surge, flooding, and hurricanes. In recent years, the Carolinas have been impacted by several billion-dollar events (losses in damage and life)[4], including the record flooding in South Carolina in 2015 (Oct 1-5), Hurricane Matthew in 2016 (Oct 7-9), and Hurricane Florence in 2018 (Sept 13-18).

Climate change is intensifying the risk, frequency, and severity of natural disasters, especially climate-sensitive disasters relating to hydrological and meteorological hazards posing significant threats to mental health and well-being.[5] Roughly 1 out of 4 Americans are under the age of 18 (i.e., ~74 million) and recent estimates show that 14% of individuals in this age group have been exposed to a disaster in their lifetime.[6] Dose-response patterns exhibiting increasing exposure and subsequent increases in a wide range of mental health consequences have been identified in adolescents post-hurricane, including serious emotional disturbances[7], reactive aggression[8,9], depression, anxiety[10] and existential anxiety[11], post-traumatic stress disorder (PTSD)[12-16], identity distress[17], sleep disturbance[18], and poor academic achievement[9]. A significant number of empirical studies have documented the persistent effects of disaster-related stressors in young survivors for up to two years and beyond following a hurricane resulting in a

disproportionately high prevalence of anxiety, depression, post-traumatic stress, and suicidal ideation[19-31].

While there are multiple drivers in the pathway of psychological disorders following a weather-related disaster, a few potential mechanisms in which climate may be linked to amplified mental health risks include: aggravating root causes of mental illness, traumatic experience, strain on public health-related resources, excess exposure to thermal stress, and loss of individual mental health resources.[2]

Examining the mental health of youth post-disaster may serve as an indicator of recovery efforts and be used to inform targeted interventions in this high-risk group.[32] Crisis text-based counseling services have proven to be an effective and low-cost means of delivering mental health support to individuals struggling with thoughts of suicidality, hopelessness and psychological pain.[33,34] Yet limited research has examined the level of utilization of these mobile crisis counseling services in addressing the psychological impact on youth affected by weather-related disasters.

The objective of this retrospective, interrupted time-series study was to evaluate pre- and post-changes in crisis-support seeking patterns among youth impacted in the Carolinas (North Carolina and South Carolina) during and following Hurricane Florence in 2018. Our main hypothesis concerning the impact model of Florence assumed text volume temporarily increased immediately and in the weeks after the storm (i.e., temporary level and slope change). To our knowledge, our study is the first to examine crisis help-seeking behaviors across a large population of youth immediately following a large natural disaster.

METHODS

Storm Impact on Study area

Hurricane Florence (Sept ~13-18th, 2018) made landfall along the coast of North Carolina as a category one storm.[35] Florence was a slow-moving hurricane that generated more than 10 inches of rainfall along the coasts of North Carolina (NC) and South Carolina (SC); whereby historic tropical cyclone rainfall records were exceeded in both states (NC: 39.9 inches for Florence compared to 24.1 inches for Hurricane Floyd in 1999; SC: 23.6 inches for Florence compared to 17.5 inches for Tropical Storm Beryl in 1994).[35] These high-volume rains, in turn, caused substantial low-land and river flooding throughout the Carolinas and surpassed flood stage records captured during Hurricane Matthew in 2016.[36] The NOAA National Centers for Environmental Information (NCEI) estimated damages from wind and water during Florence resulted in $24 billion in losses (e.g., societal disruptions, property damage) and 47 deaths.[35] The damage incurred from Florence in North Carolina exceeds the cost of damages exacted during Hurricanes Matthew (2026) and Floyd (1999) combined.[37]

Crisis-text data

Data on crisis help-seeking patterns were obtained from Crisis Text Line (CTL), a global not-for-profit organization that provides free, 24/7 confidential crisis intervention via a text message platform to youth and young adult populations. These data have been used in the context of open data collaborators[38] to understand the relationship between crisis-help seeking in response to temperature extremes[39], the release of the Netflix series *13 Reasons Why*[40,41]*,* and rural versus urban differences in the use of these technology-supported crisis interventions in youth[42] The basic premise is that an individual in crisis can text into the service and be

connected with a trained Crisis Counselor. Following each conversation, the counselor assigns

data labels to the 'texter's issue' or topic areas discussed (e.g., anxiety, stress, suicidal thoughts)

based on a list of 35 options (see supplemental Table 1). In some scenarios, a texter can report

multiple issues during a conversation. We then used text-mining software to separately code and

label the issues discussed for each crisis conversation.

Daily CTL conversation counts were aggregated for all NC and SC area codes for the

following outcomes before and after the storm: (1) any crisis-text; (2) stress and anxiety; (3)

depression; and (4) suicidal ideation. All crisis texts were deidentified to protect privacy and

details on the user's name, date of birth, phone number or contents of the message and were

provided for 01 January 2018 to 31 October 2018. This time period was the only data available

for sharing at the time of the study team's request. Data on demographic characteristics were

available for a small subset of users (approximately 20% of texters) who agreed to supply these

details through a post-conversation survey but were not included in the analysis due to the small

sample size.

Since CTL's inception in 2013, crisis counselors have facilitated over 105 million

conversations with individuals in crisis. Although CTL crisis services are widely disseminated at

the local community level through partnerships with schools, public health officials, and

community partners, no strategic efforts are currently made to leverage existing dissemination

channels to get the word out about these crisis counseling services in communities impacted by a

weather-related disaster. To date, national crisis trends reflect that about 25% of texting volume

in NC in SC have been related to anxiety stress (NC ranked 22 and SC 32), 30 to 35% related to

depression/sadness (NC ranked 10 and SC 11), and 20 to 25% related to suicide compared to

about 20-25% for suicide (NC ranked 39 and SC 43).

Emergency Department Visits

Daily emergency department visits for the same period 01 January 2018 to 31 October 2018 were obtained from the North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT), a statewide surveillance system. ED visits were categorized based on the following *International Classification of Diseases, Tenth Revision, Clinical Modification*[43] (ICD-10-CM) diagnosis codes: 1) all mental health disorders (F00 to F99); 2) anxiety (F40 - F48); 3) depression (F32-F33); and 4) suicidal ideation (R45.851).

All ED visits were associated with the county of residence only for youth (age 15 to 24 years) impacted by the storm in North Carolina. Relying on FEMA Disaster Declaration maps for North Carolina[44], we assigned each county to one of three Hurricane Florence exposure groups: 1) *directly impacted* counties defined as those who received both individual and public assistance; 2) *indirectly* impacted counties for those who received either individual or public assistance; and 3) *no impact* for counties who received no designation.

Intervention periods

The study period was restricted to Jan 1 to Oct 31, 2018, based on the available data provided by CTL. We categorized the pre-intervention period as Jan 1, 2018, to September 12, 2018, and the post-intervention period as of September 19, 2018, to October 31, 2018. To evaluate changes in crisis text volume in youth following Florence, we examined the immediate impact on CTL volume during the storm (September 13, 2018, to September 18, 2018) and for three separate post-intervention scenarios: (1) *acute impact* on CTL volume in the two weeks post-Florence (September 18, 2018, to October 2, 2018); (2) *immediate, continuing impact* on CTL volume ~6 weeks after the storm (September 13, 2018, to October 31, 2018); and (3)

delayed, but continuing impact on CTL volume 45 days after the storm (September 19, 2018, to October 31, 2018). The time-series included a total of 304 days of crisis-text observations, with 253 days of pre-Florence data and a post-Florence intervention period of 51 days. The specified autoregressive (AR1) model included the effect of Hurricane Florence (i.e., I= intervention) on the dependent variable (i.e., daily crisis texts) during (September 13-18, 2018) and after the storm (September 19, 2018, to October 31, 2018):

Equation (1): $(Yt) = \mu + \omega_1 I_{1,t} + a_t$

where Y_t is the dependent variable representing the logarithmic transformation of daily crisis text counts for each of the defined outcomes (i.e., daily texts for youth in North and South Carolina combined), t indexes time, μ is the mean term, $\omega_1 I_1$ is the continual effect of the intervention on the dependent variable during the subsequent 51 days, i.e., the percent change after the intervention. Log-transformed daily counts of crisis texts were used to stabilize variance and can be interpreted as a percent change in daily text volume post-Florence. The right-hand side of Equation (1) characterizes the AR(1) noise process; whereby a_t is the random error term.

Statistical Analysis

Descriptive statistics were performed to examine the mean daily CTL volume with a 95% confidence interval for each intervention period. T-tests were used to examine whether mean daily CTL text volume for each outcome differed by intervention period (pre/post) ($\alpha=0.05$).

We performed an interrupted time series (ITS)[45-47] analysis to capture the immediate or gradual impact of crisis text patterns in the Carolinas before and after Florence. Autoregressive Integrated Moving Average (ARIMA) models were employed to analyze repeated measures of daily CTL volume data and address autocorrelation between time-series. ARIMA models are a

flexible and sophisticated class of time-series models that allow for intervention hypothesis testing. We examined the various fit of autoregressive, moving average, or autoregressive moving average models by stepping through a standardized model fit exercise: (1) model identification, (2) parameter estimation, (3) diagnostic checking for each outcome, (4) intervention testing, and (5) forecasting.[48] Model fit was assessed using a number of measures: autocorrelation check for white noise, visual autocorrelation function (ACF), partial autocorrelation function (PACF), and ICAF plots, AIC and SBC criteria, and residual correlation and normality diagnostics were used to select the simplest and best-fit model.[48] The forecasting procedure in Proc ARIMA was used to generate one-step-ahead predictions of the time series using historical data from the fitted model to compare actual versus predicted counts of daily text in the post-intervention period.

Sensitivity Analysis: Changes in ED volume for NC

The storm impacted more individuals (n=34,710 applications approved for individual assistance) and counties ($n = 57$ out of 100 counties received major disaster declaration) in North Carolina compared to South Carolina ($n = 5,175$ applications approved for individual assistance, 19 out 46 counties received major disaster declaration). In a sensitivity analysis, we examined pre- and post-Florence changes in NC emergency department volume for the following mental health condition categories: 1) any mental health condition, 2) anxiety, 3) depression, or 4) suicidal ideation/thoughts.

All ITS analyses were performed using PROC Arima in SAS 9.4[49] and statistical significance was considered at $p<.05$.

Results

Figure 1 shows daily CTL text volume for each outcome for the duration of the time series (Jan 1 to Oct 31, 2018). CTL volume for any reason peaked 5 and 13 days after the storm, while suicidal thoughts peaked around day 6 and depression peaked on day 13 post-Florence. Table 1 shows the summary statistics on the daily mean for each outcome by the intervention period. We observed significantly more crisis texts for anxiety and stress, as well as suicidal thoughts in the two weeks after Florence compared to the pre-intervention period. Daily text volume for anxiety and stress, depression, and suicidal thoughts were significantly higher in the six weeks after the storm compared to the pre-intervention period.

Intervention Models for Post-Florence Crisis Text

The multiplicative autoregressive ARMA (1,0) model was the best-fit model to examine the change in daily crisis text counts. We observed no seasonal lag in daily crisis text volume within the period examined and therefore did not adjust for seasonality in our models. The impact model results for each outcome for the different intervention scenarios are shown in Table 2. We observed that shocks to the daily crisis text rate for each outcome during and immediately after the storm were felt in subsequent days following the storm (Figure 2 a-d). Results showed a statistically significant positive intervention effect for crisis texts related to (1) anxiety & stress and (2) suicidal thoughts for the immediate, continuing impact intervention period, as well as the delayed, continuing impact period post-Florence (Table 2). We observed an immediate 16% (SE=.05, *p*=0.005) and 22% (SE=.07, *p*=0.02) increase in crisis texts for anxiety/stress and suicidal thoughts, respectively, once the storm commenced and a delayed 17% and a 23% increase in texts for anxiety/stress (SE=.08, *p*=0.005) and suicidal ideation (SE=.08, *p*=0.01) after Florence, respectively. Although only marginally significant, an 20% (SE=.10, *p*=0.09) increase in anxiety/stress texts were detected in the two weeks after the storm and an

11% (SE=.06, *p*=0.08) increase in depression-related texts occurred in the post-intervention period. Results confirm our hypothesis that Hurricane Florence generated an immediate and temporary increase in crisis-text patterns in the six weeks following the storm.

Forecast Modeling of Suicidal Thoughts

Using the AR(1) model, we forecasted daily future crisis texts for youth in the Carolinas post-Florence for each of the intervention periods. The results are one-step-ahead predictions for the first 45 days after the storm. In general, crisis text volume was higher than expected for all four outcomes.

Sensitivity Analysis for NC ED Volume

Daily ED volume increased from the pre- (daily mean of ED visits = 64.5) to post-intervention period (daily mean for ED visits = 73.0) for directly impacted counties (t= -7.06, *p* <.0001) compared to a decrease in mean ED post-Florence (pre-Florence daily mean for ED visits= 91.3 compared to post-daily mean= 83.7; t=5.00 *p* <.001) for the indirectly impacted communities and no change in ED volume for counties not impacted by the storm (Supplemental Figure 1). ED visits for any mental health condition in youth peaked around 8 days after the storm compared to visits related to depression that peaked around 2 and 5 weeks after the storm. Visits to the ED for suicidal ideation peaked around a week after the storm and then spiked again 5 weeks later.

Similar to the CTL analysis, we used the AR(1) model to examine the delayed, but the continuing impact of Hurricane Florence on changes in daily ED volume for each of the four mental health conditions in youth. After Florence, we observed a significant 16% increase in ED visits for all mental health conditions (Figure 3a), a 21% higher ED volume for depression

(Figure 3b), a 33% increase in visits for suicidal ideation with a peak around 2 weeks and 1 month after the storm (Figure 3c), and 23% more ED visits for anxiety among youth (Figure 3d). ED volume for all four conditions abruptly dropped during the week of the storm for impacted communities.

Discussion

This study examined the impact of Hurricane Florence on daily crisis text patterns for youth in the Carolinas. Our results are an original contribution to the literature and are the first to assess help-seeking behaviors in an impacted population before, during, and after a catastrophic hurricane. We found a significant and sustained increase in crisis-texts for two mental health outcomes –anxiety/stress and suicidal thoughts– immediately after Hurricane Florence. After controlling for recent shocks in local crisis text patterns (i.e., the AR(1) term), we conclude that the initial and sustained increase in mean crisis-texts post-disaster is likely reflective of the mental health experience of youth in the Carolinas associated with Hurricane Florence and is not likely due to an alternative unobserved factor.

These results were confirmed by a sensitivity analysis examining changes in ED volume among youth in directly impacted communities in North Carolina. In general, we observed a 16% increase in any mental health-related ED visits for youth age 15 to 24 after Florence. ED volume in this group was higher than crisis text volume for all three conditions: anxiety-related ED visits increased 23 % (compared to 17% in CTL volume), depression-related ED visits increased 21% (compared to 11% in CTL volume), and ED visits for suicidal thoughts / ideation increased 33% (compared to 23% in CTL volume).

Typically, communities impacted by a natural disaster (e.g., catastrophic hurricane) do not have enough counselors trained to provide youth with the mental health care services they

need after a disaster, particularly in the initial impact period.[50,51] Our results highlight a notable increase in help-seeking behaviors for trauma-related symptoms (e.g., depression, stress, and anxiety) among youth following Florence. Pina et al. noted that greater helpfulness from extra-familial sources of social support predicted lower levels of youth-reported symptoms of post-traumatic stress disorder, anxiety, and depression post-Katrina.[52] Encouragingly, our results highlight willingness among this vulnerable, youthful population to use a text-based crisis counseling platform (i.e., Crisis Text Line) to address their mental health support needs outside of traditional, clinic-based individual therapy.

We observed a significant spike in mental health-related symptoms, including anxiety and stress, post-Florence. Our results are troubling as chronic anxiety is the strongest predictor for more severe, longer-lasting post-traumatic stress conditions among youth following other hurricane events, such as high-intensity storms Andrew (August 1992) and Katrina (August 2005).[51,53,54] In the general population, self-reported mental health outcomes, including PTSD, anxiety, and depression, have exhibited peaks in occurrence following large hurricane-related flooding events, similar to those experienced following Hurricane Florence.[55]

Early disaster research has linked hurricane exposure with a 31% increase in suicides in the two years following the event among populations directly exposed.[24] Research has also shown an increased prevalence of post-traumatic stress disorder, major depressive disorder, and anxiety disorders, as important risk factors for suicidal thinking.[24,56,57] Temporarily, we found a strong and immediate short term increase in help-seeking behaviors for suicidal thoughts following Hurricane Florence and then a smaller delayed increase in texts associated with suicidal thoughts within six weeks of the event.

Contrary to our results, previous research has recorded an immediate drop in suicidal

ideation and non-fatal suicidal-related behaviors in the initial post-disaster period as being

attributable to the "honeymoon" phase[58] in which impacted members of the community mount a

"pull it together" response.[59] Yet, follow-up studies have generally demonstrated an increase in

suicidality starting around the 6-month mark, when the "honeymoon" phase is wearing off and

the reality of new normal arises during recovery efforts.[60,61] For instance, Kessler et al.[60],

examined suicidality following Hurricane Katrina, and noted a delayed increase in severe mental

illness, suicidal ideation plans, and PTSD, although their results were examined over a more

extended time period (e.g., one-year post-hurricane) than our study (e.g., six weeks). Our results

are the first to identify an increase in suicidal thoughts during the initial impact phase and

highlight the need to promote text-based mental health services like Crisis Text Line.

Strengths and Limitations.

Our study contributes to the literature in several significant ways. First, unlike the

previous research[50,60,62], which focused on survey-responses, psychometric screening scales, and

clinical interviews, our study uses an interrupted time-series design. An interrupted time-series

design accounts for confounding factors by taking into account pre-intervention trends to better

characterize the impact (i.e., level, slope, and changing pattern) and thus is considered a robust

tool for evaluating the longitudinal impact of a large scale hurricane (i.e., "natural experiment")

with a specific time of onset.[63,64] Additional strengths included the use of daily counts for texting

behavior from a nationally available crisis text platform ($n=304$ time points) compared to weekly

or monthly counts which significantly increased power to detect a true difference in crisis

behaviors in the post-intervention period, as well as ARIMA models allow for the adjustment of

autocorrelation to account for the delayed influence of crisis texts for a particular outcome earlier in the time-series and the detection of seasonality.

Additionally, our study examined a wide range of topics about which individuals sought help, including stress, anxiety, depression, and suicidal thoughts, thus providing a broader assessment of mental health concerns and potential crisis events post-hurricane than previous studies which predominantly focused on PTSD and acute stress disorders (e.g., Norris et al. 2002 [65]). Our focused analysis of a text-based platform, which provides a more immediate method of capturing the psychological response of young people compared to traditional survey methodologies, may explain why our results differ from previous research.

Due to the small sample size of daily texts for each of the outcomes aggregated for North and South Carolina combined, we could not examine changes in daily text rates for individual area codes separately to approximate storm impact (i.e., tease out the difference between highest exposed area and less-exposed areas). Further, because we used aggregated and de-identified crisis text data, we were unable to discern the effect of pre-existing mental health conditions (e.g., previous diagnosis of anxiety or depression) on post-Florence call volume. Research has shown that the mental health consequences of a disaster among survivors with a pre-existing mental health condition (e.g., anxiety, depression) are more severe compared to youth with new and emergent psychological sequelae.[66] However, state-level data on emergency department visits and mental health care utilization for North Carolina in 2018 confirmed trends identified in the CTL text data and showed the magnitude mental health conditions post-storm for youth in the most impacted areas.

Individual-level risk factors involved in influencing the differential effects of hurricane exposure and experience in youth (i.e., youth adaptation) are low socioeconomic standing,

previous experience with a natural disaster, pre-existing mental health conditions (e.g., anxiety, depression, suicidal thoughts), social support, discrimination, and disruption in access to mental health services and medication.[31,67] We were unable to differentiate if individual-level factors influenced the magnitude of crisis events associated with the increase in adolescent texting behavior, despite previous research showing disparities in mental health outcomes post-disaster among specific sub-populations.[68] CTL captures volunteer demographic data on texters by sending out a follow-up survey after the call, but only about 4 out of 10 texters complete the survey. Lastly, de-identified crisis conversations did not include information on the magnitude of impact for CTL-users post-storm, and if they or their families were directly impacted through property damage, death, or injury or indirectly exposed as the result of repeated media exposure on the event. Proximity to hurricanes and hurricane-related impacts are important predictors for both immediate and long-lasting mental health impacts (e.g., Furr et al. 2010, Schwartz et al. 2017 [68,69]).

Directions for Future Research.

To date, no published studies were located that used CTL data to examine help-seeking behavior before and after a major hurricane. More research on determining the efficacy of CTL-derived preventive and early intervention crisis service delivery among youth is needed to understand how this low-cost service can be leveraged to reduce the psychological distress of weather-related disasters. Over two decades of research suggests that schools are a de facto mental health system for adolescents.[70,71] and school-based interventions have shown a tremendous amount of potential for improving the mental health of this highly vulnerable group by providing enhanced social support[72] and bolstering emotional well-being[73] post-hurricane. A new avenue of research might involve coupling and mobilizing available services in the schools

where these climate events take place and deploying them strategically and immediately in the aftermath (e.g., Banks and Weems 2014, Kirk et al. 2018 [74,75]). Strategic partnerships involving CTL, the public and mental health community, and schools located in disaster impacted areas may one day involve widely disseminating CTL services as a standard mental health crisis intervention protocol in disaster torn communities.

Now with the rapid pace and reach of these texted-based media platforms, we have the capacity for situation monitoring to mitigate the impact of disasters in youth. CTL services could be used to target mental health and other social support resources for youth exposed to hurricane-related stress and trauma in both the immediate and prolonged exposure periods. CTL can also be leveraged by the public health and disaster response community as a real-time screening tool to identify impacted areas with persons who are the most in need of supplemental mental health services and monitor the effectiveness of post-disaster mental health interventions.

Crisis text line counselors are volunteer-based and undergo a rigorous 200-hour training program. In addition, the current CTL volunteer workforce in the United States is substantial (approximately 5000). Training includes reflective listening, collaborative problem-solving, and crisis management; however, training materials do not specifically address how to respond to severe disruptions occurring in the aftermath of a natural disaster or extreme weather event. Research examining the need for pre-event training among CTL counselors based on the core principles of Psychological First Aid[76] can be used to identify areas in which counselors feel underprepared to address the mental health consequences in youth following a weather-related disaster.

Conclusions.

A lack of mental health resources has been cited as a significant challenge in the aftermath of weather-related disasters. This challenge is particularly problematic for youth, a group that is especially vulnerable to the mental health consequences of disasters and who are typically reluctant to seek help for mental health problems due to misinformation or perceived stigma attached to the receipt of these services. Critical to post-disaster recovery is the ability of a community to address mental health needs, specifically through adequate resources and timely interventions. Technology-based platforms, like Crisis Text Line, provide an opportunity for fast, cost-effective crisis counseling following natural disasters and can be used to lessen the mental health impact in youth post-disaster by increasing the reach while simultaneously reducing the time it takes to access these safety net mental health services.

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